

REMARKS

Claims 1 – 28 have been examined. Claims 1, 3, 4, 7, 11 – 15, 17, 18, 26, and 27 stand rejected under 35 U.S.C. §102(e) as anticipated by U.S. Pat. No. 6,846,745 (“the '745 patent”); and Claims 1 – 28 stand rejected under 35 U.S.C. §103(a) as unpatentable over the '745 patent in view of U.S. Pat. No. 6,794,290 (“the '290 patent”).

Independent Claims 1 and 26 have been amended to recite aspects of the invention more specifically. In particular, such amendments preclude the construction proposed in the Office Action in which the “halogen precursor” and the “hydrogen precursor” recited in Claim 1 are a single compound or in which the “first precursor gas” and “second precursor gas” recited in Claim 26 are a single compound. Specifically, these claims now require that these precursors be flowed into the processing chamber at respective flow rates to control chemical interaction between them (*see* Application, p. 9, ll. 19 – 21; ll. 29 – 31). The requirement that chemical interaction between the precursors inherently requires that the recited precursors be separate. It is noted that independent Claim 20 already recites a fluorine-containing gas and H₂ as precursors so that the separateness of these precursors is explicit.

The use of separate precursors meeting the claim requirements is not taught or suggested by the '745 patent, and the §102 rejections are accordingly obviated. Since claims that required separate precursors were rejected under §103 over the combination of the '745 and '290 patents, the following remarks are offered regarding the proposed combination in the interest of advancing prosecution of the application.

The '745 patent is directed generally to a dep/etch/dep process that uses a chemical fluorine etch ('745 patent, Col. 3, ll. 59 – 61). The '290 patent is directed generally to a dep/etch/dep process that uses hydrogen during the etch step to provide a chemical etch ('290 patent, Col. 7, ll. 21 – 22). The Office Action to combine these teachings in a chemical etching step that uses both fluorine and hydrogen, identifying as a motivation for the combination that “utilizing H₂ as an etchant ... allows for achieving better process control” (Office Action, p. 6). Applicants respectfully disagree with this proposal for several reasons.

First, the improved process control identified in the '290 patent as a benefit of a chemical hydrogen etch is a consequence of the different chemistry provided by hydrogen interaction with SiO₂ as compared with fluorine interaction (*see* '290 patent, Col. 6, l. 65 – Col. 7, l. 32). The '290 patent notes in particular that the hydrogen chemistry provides etch rates on

the order of 100 Å/min as compared with about 1kÅ/min when fluorine chemistry is used. To combine the fluorine etch described in the '745 patent with the hydrogen etch described in the '290 patent would result in a process dominated by the higher etch rate of the fluorine chemistry. The improved process control described in the '290 patent would not be achieved because the combined process would still use the conventional fluorine chemistry. *See* MPEP 2143 noting that no *prima facie* case is made out under §103 absent a motivation to combine reference teachings.

Second, the Office Action's proposal does not account for the potential chemical interaction during the combined process between the fluorine and the hydrogen. Since there is no explicit suggestion in the '745 patent of adding a separate hydrogen-precursor flow, nor any explicit suggestion in the '290 patent of using the hydrogen etching in combination with fluorine etching, it is mere speculation how the combined process might work. The prior art provides no reasonable expectation of success without some teaching regarding how the potential chemical interaction of combining the processes would be manifested. *See* MPEP 2143 requiring a reasonable expectation of success in establishing a *prima facie* case under §103.

It is Applicants' invention that fills this gap in the prior art. In particular, it is Applicants who have recognized that a dep/etch/dep process that combines separate halogen-precursor flows with hydrogen-precursor flows advantageously provides a chemistry that improves control over etching effects. The Application notes that, in addition to having the hydrogen precursor act as a diluent, the hydrogen precursor provides scavenging hydrogen atoms and ions that react with the halogen atoms in the plasma to permit control to be exerted over the etch rate by adjusting relative flow rates (Application, p. 9, ll. 28 –31). This capability permits the relative isotropic and anisotropic contributions to the etch to be controlled (*id.*, p. 9, l. 31 – p. 10, l. 4) and when combined with variations in flows to particular nozzles permits variations in etch rates across a substrate to be achieved (*id.*, p. 12, ll. 10 – 26).

Not only does the cited art not provide any explicit suggestion of combining the fluorine-based etch of the '745 patent with a hydrogen-based etch of the '290 patent, there is explicit language in the '290 patent that teaches away from such a combination. The Examiner's attention is drawn to the discussion at Col. 7, ll. 40 – 46 of the '290 patent where suggestions are made that omitting fluorine in the process advantageously avoids loading and process drift effects between wafers and prevents the incorporation of impurities:

The hydrogen etch of the present invention does not exhibit loading and process drift effects between wafers, as is common with fluorine-based etch processes, thereby allowing high repeatability between applications. Additionally, use of H₂ for etching the overhang prevents the incorporation of dopants/impurities (such as fluorine) into the film, thus improving its properties and performance.

(290 patent, Col. 7, ll. 40 – 46).

Such teaching away has long been recognized as a significant factor evidencing the *lack* of a motivation to make a proposed combination of reference teachings.


For these reasons, each of independent Claims 1, 20, and 26 is now believed to be patentable. The claims that depend from those claims are additionally believed to be patentable by virtue of their dependence from a patentable claim.

CONCLUSION

In view of the foregoing, Applicants believe all claims now pending in this Application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 303-571-4000.

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